# Registration as Research Student for Doctoral Degree

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# Synopsis for Registration as Research Scholar

# For

# Doctoral Degree

# On

# Design and Development of Intelligent Controller for Greenhouse Automation


By

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**Abstract**

**The economy of India is as diverse as it is large, with a number of major sectors including manufacturing industries, agriculture, textiles and handicrafts, and services. Agriculture is a major component of the Indian economy, more than 75% of our people have their live hood as agriculture and agriculture oriented works.**
**With the help of modern technology precision agriculture can make agriculture operation more efficient and proficient. Greenhouses provide facility for modern cultivation. With the help of controlled environment, fertilizers and automation of irrigation system, it is possible to increase quality and quantity of the crop. Therefore there is need to use modern intelligent control technology, sensor technology for monitoring and controlling of greenhouse parameters optimally to meet crop need**.

## 1. Introduction.

Agricultural Sector of Indian Economy is one of the most significant part of India. Agriculture is the only means of living for almost two-thirds of the employed class in India. Nearly 50% of the national income of India is derived from agriculture.
We must adopt all possible methods to improve our agriculture and raise its productivity. The natural factors militating against the raising of agricultural productivity must be overcome. Use of advanced technology made new trends to emerge in agriculture section.
Greenhouses provide facility for modern agriculture cultivation. Plant cultivation in greenhouse in influence by various factors such as soil quality, water availability, climatic conditions and appropriate use of fertilizers.
In order to maximize efficiency and optimize quality, greenhouse is equipped with modern controller and monitoring system. It replaces direct human supervision. Farmer in rural areas will be benefited by designing and developing new technologies in greenhouse automation which are user friendly, easily operatable to meet crop need to get good quality and quantity of crop.
A large amount of literature is available about the application of classical dynamic system and control theory in the areas of greenhouse modelling and control.
The approach proposed here is in the direction of intelligent control methodologies and soft computing methodologies cantered on fuzzy logic, genetic algorithm, ANN to obtain robustness and low solution cost.
It is difficult to establish precise mathematical model of greenhouse climate which describes the response of the greenhouse climate to the external influences such as solar radiation, outside humidity, wind speed, outside air temperature. By using Soft computing methods the modelling of some complex behaviour can be easily achieved by input-output data learning using artificial neural network. The use of fuzzy logic controller is essential for implementation of human expert abilities in the field of greenhouse in order to avoid damage to plant.

The subject of this work is to use intelligent control techniques in the field of greenhouse climate control. Soft computing methodologies can be considered as an alternative to the traditional nonlinear control system.

## 2. Review of Literature and Development in the subject (Previous work done in the relevant area):

Literature survey brief different architecture technology and monitoring system used for greenhouse parameter.

Yunseop Kim et.al [2008][1] describes distributed in field sensor based irrigation system to maximize productivity. Wireless sensor network and software is used for real time in field sensing and control of irrigation system. An irrigation system is controlled by programmable logic controller (PLC) with data collection using GPS (Global Positioning System).

P.Javadikia et.al [2009][2] has developed an irrigation controller using fuzzy logic methodology based on C Mamedani controller using MATLAB software. He has compared three system on-off controller, on-off controller with hysteresis and fuzzy logic controller and concluded that the fuzzy logic based system is very simple to implement.

Peng Li et.al [2012][3] proposed wireless data acquisition system based on wireless sensor network based on Zigbeeprotocol.WSN collect the environmental information and transmit data to server for further processing. The server is central monitoring platform based on development of Java platform.

KoushikAnand et.al [2015] [4] has proposed drip irrigation method based on WSN and mobile technology for greenhouse automation. Air temperature and soil humidity are sensed on sent to hub. The hubs process the data using fuzzy logic and decide the proper control action. Paper has implemented three features drip irrigation, mobile network and fuzzy technique.

KasimM.Al -Aubidy et.al [2014][5] has developed single board microcontroller based system for real time monitoring and control of greenhouse parameter using rule based fuzzy logic.ATMEGA 256015 microcontroller used to receive data and generate required control action based on knowledge based fuzzy system.

Mingjin Yang et.al [2014][6] has developed multi-input and multi output control and monitoring system of greenhouse based on FLC. Based on certain algorithm reliability of system has improved.

M Guerbaoui et.al [2013][7] has proposed direct fuzzy logic based greenhouse temperature monitoring system. LABVIEW software is used for real time monitoring of greenhouse system. The software is based on graphical user interface (GUI).It displays the current value of the greenhouse parameter to be monitor and control along with fuzzy control parameter. It has also features to enter new set point.

R Caponetto et.al [2000][8] has proposed methodology based on artificial intelligence (AI) technique for modelling and control of some environmental variable inside greenhouse. Soft computing methodologies cantered on fuzzy logic, genetic algorithm, ANN to obtain robustness and low solution cost. The simulator has been developed using Simulink tool within MATLAB software.

M.Azaza et.al [2016] [9] has proposed Type-2 fuzzy logic control technology to encounter the system non linearity. Particularly temperature and humidity correlation was addressed and decoupling control strategy was introduced. The system was enhanced by smart data monitoring system. Database was built for future enhancement of system accuracy.

J.L.Rivas et.al [2012] [10] has described the development of virtual and remote Lab for greenhouse climate control. User has to only once learn how GUI works since both real and virtual share same configuration.

Lukas Bajer et.al [2015] [11] has proposed automation of garden greenhouse environment. For the environment with large number of influencing variable he gas chosen optimal controller based on Arduino platform i.e. Arduino MEGA 2560 which allows use of multiple sensors and able to manage a wide range of actuators.

S.Mohammed et.al [2015] [12] has proposed application of Adaptive Neuro–Fuzzy inference system (ANFIS) to the control of greenhouse climate system. To improve system performance a Genetic Algorithm (GA) is used to adapt the controller parameter such as shape of membership function, scaling parameter. Simulation result show that controller provide smooth control regardless of continuously varying climatic conditions

## 3. Objectives of Research

1. To understand the physiology of the particular crop and environmental changes taking place in greenhouse due to effect of various internal and external parameters.
2. To analyze and study the control parameter in greenhouse and their interaction with environment.
3. To develop a Simulink model to study the effect of various greenhouse parameter on crop quality and quantity.
4. To develop algorithm for controller using various soft computing methods which can control various input parameter as per the need of the crop in greenhouse.

**4. Methodology followed to achieve above objective is summarized below.**

The aim of the research is to obtain good quality and quantity of crop by optimizing all parameter like water, air temperature, air humidity, sunlight, $CO_2$ generation, energy and cost. To satisfy this aim the methodologies are summarised as follows

- The Simulation model understanding the effect of different parameter on greenhouse environment can be developed by using software like MATLAB, ETAB, and LABVIEW.
- Controller algorithm can be developed based on different intelligent control techniques like knowledge based fuzzy logic, artificial neural networks (ANNs), genetic algorithm (GA), conventional controller in combination with artificial intelligence controller (AI), and hybrid controller.
- Real time monitoring system can be developed with knowledge of instrumentation system and software/ hardware interface.

**5. Importance of study/ Society application**

India is the country of agriculture. According to 2015 census of India 68.84% Indians live in different villages and fully depends on agriculture. In India, agriculture is the backbone of the economy. Nearly 50 per cent of the national income of India is derived from agriculture
A modern greenhouse production is referred as control environment agriculture. The technique for climate control tune up crop needs and avoid unnecessary energy consumption. By developing low cost, efficient greenhouse automation technique, farmer in rural area can be benefited by automatic monitoring and control of greenhouse.

**6. Proposed work Plan/ Formulation and Structure of Study:**
**Year-wise Plan of work and targets to be achieved**

| Sr. No. | Year | Details of work carried out |
|---|---|---|
| 1 | 2016-17 | Literature Survey. Problem Formulation and Synopsis Write up. Course work completion and developing simulation models of greenhouse and study the effect of different parameter on greenhouse climate and parameter to be controlled to tune crop needs. (Objective-1) |
| 2 | 2017-18 | To study and collect data for particular crop to understand the crop need to increase quality and quantity of crop. (Objective-2) and identify suitable soft-computing techniques required for controller. (Objective-3) |
| 3 | 2018-19 | To implement intelligent soft-computing methods and develop real time monitoring system based on knowledge of instrumentation system and software/hardware interface. (Objective-4) Summarization, comparative analysis and publications |

**7. References:**


1. Yunseop Kim, RobertG. Evance, William M. Iversen, "Remote Sensing And Control of an Irrigation System using Distributed Wireless sensor Network" *IEEE Transaction on Instrumentation and Measurement*, Vol. 57,July 2008, pp. 1379-1385.
2. P.Javadikia Kia, A TabatabaeeFar,M Omid ,R Alimardani, "Intelligent Control Based Fuzzy Logic For automation Of Greenhouse Irrigation system And evaluation In relation to Conventional System,"*World Applied Science Journal* 6(1), 2009,pp.16-23.
3. Peng Li,yunjie Wu, "A wireless data acquisition system designed for greenhouse based on ZigBee" *Proceedings of the 10th World Congress on Intelligent Control And Automation.*July 6-8, 2008, Beijing,China.
4. KoushikAnand,Dr.C.Jaykumar,MohanaMuttu ," Automatic Irrigation system Using Fuzzy logic And mobile Technology" *IEEE international conference on Technological Innovations In ICT for Agriculture and Rural development*,2015
5. Kasim M A, Mohammad M Ali, Ahmed M Derbas,Abdallah W Al Mutairi, "Real-Time Monitoring And intelligent Control For Greenhouse Based Om Wireless sensor Network", *System ,Signal and Devicec(SSD), 11th International Conference* ,2014.
6. MingjinYang,XiwenLi,RenquanYang, "Greenhouse Environment Control and Monitoring system in the Hilly Area of Chongqing ", 2011 *Fourth International Conference on Intelligent Computation Technology and Automation.*
7. M.Guerbaoui,A.Ed-dahhak,Y.Eiafou,A.Lachhab,"Implementation Of Direct Fuzzy Controller in greenhouse Based On LABVIEW*", International Journal Of Electrical and Electronics engineering Studies* ,Vol.1,pp.1-13,Sept-2013.
8. R.Caponetto,L.Fortuna,G.Nunnari,L.Ochipinfi,M.G.xibilia,"Soft Computing For Greenhouse Climate Control",*IEEE Transaction on Fuzzy system*,Vol.8 ,No.6,pp.753-760,December 2000
9. M.Azaza, C Tanougast, E.Fabrizio, A.Mami ,"Smart greenhouse fuzzy logic based control system enhanced with wireless data monitoring", *ISA transaction*,Vol.61,PP.297-307,May 2016
10. J.L.Rivas,J.L.Guzman,F.Rodrigues,M.Bernguel,S.Dormido,"Integrated virtual and remote lab for greenhouse climate control",*IFAC proceedings* ,Vol.45 pp.264-269 ,2012
11. Lukas Bajer,OndrejKrejcar," Design and Realization of Low Cost control for Greenhouse Environment with Remote Control", *IFAC-paper on line*,pp.368-378 ,2015
12. S.Mohammed ,I.A.Hammed"A GA-Based Adaptive Neuro-Fuzzy Controller for Greenhouse Climate control System", *Alexandia Engineering Journal* ,Nov-2015.


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